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PCT/US99/13174

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
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in its capacity as elected Office

Date of mailing (day/month/year) 31 March 2000 (31.03.00)	
International application No. PCT/US99/13174	**Applicant's or agent's file reference** 1313/2E290-WO
International filing date (day/month/year) 08 June 1999 (08.06.99)	**Priority date** (day/month/year) 08 June 1998 (08.06.98)
Applicant WESTPHAL, James et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

07 January 2000 (07.01.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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PATENT COOPERATION TREATY

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RECD 12 DEC 2000

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 1313/2E290-WO	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US99/13174	International filing date *(day/month/year)* 08 JUNE 1999	Priority date *(day/month/year)* 08 JUNE 1998
International Patent Classification (IPC) or national classification and IPC IPC(7): A61F 13/46; and US Cl.: 604/367, 368, 378		
Applicant BUCKEYE TECHNOLOGIES INC.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 13 sheets.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

   - I [X] Basis of the report
   - II [ ] Priority
   - III [ ] Non-establishment of report with regard to novelty, inventive step or industrial applicability
   - IV [ ] Lack of unity of invention
   - V [X] Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI [ ] Certain documents cited
   - VII [ ] Certain defects in the international application
   - VIII [ ] Certain observations on the international application

Date of submission of the demand 07 JANUARY 2000	Date of completion of this report 14 NOVEMBER 2000
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JOHN G. WEISS Telephone No. (703) 308-2702

Form PCT/IPEA/409 (cover sheet) (July 1998) ★

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US99/13174

I. Basis of the report

1. With regard to the **elements** of the international application:*

[X] the international application as originally filed

[X] the description:
pages 1-10 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the claims:
pages 11, 12 , as originally filed
pages NONE , as amended (together with any statement) under Article 19
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the drawings:
pages 1 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the sequence listing part of the description:
pages NONE , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

[ ] contained in the international application in printed form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the writen sequence listing has been furnished.

4. [X] The amendments have resulted in the cancellation of:

[X] the description, pages NONE

[X] the claims, Nos. NONE

[X] the drawings, sheets/~~fig~~ NONE

5. [ ] This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

***Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US99/13174

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)	Claims	2 ,3, 5, 6, 8, 9	YES
	Claims	1, 4, 7	NO
Inventive Step (IS)	Claims	NONE	YES
	Claims	1-9	NO
Industrial Applicability (IA)	Claims	1-9	YES
	Claims	NONE	NO

2. citations and explanations (Rule 70.7)

Claims 1, 4 and 7 lack novelty under PCT Article 33(2) as being anticipated by Reising et al. (4,988,344). Reising et al. disclose a unitary absorbent structure in these claims, comprising an upper fibrous layer having a liquid acquisition zone extending to one surface, and a liquid distribution zone extending to the other surface; a lower fibrous liquid storage layer in liquid communication with the distribution zone surface of the upper layer, the storage layer including SAP particles; and a containment layer surrounding the storage layer, and extending to the outer edges of the structure; the containment layer containing the fibers, and SAP particles of the storage layer against the distribution zone surface of the upper layer. He discloses the containment layer sealed to at least one lateral edge of the structure. He also discloses the containment layer selected from the group consisting of thermoplastic film of nonwoven, and woven tissue.

Claims 2, 3, 5, 6, 8 and 9 lack an inventive step under PCT Article 33(3) as being obvious over Reising et al. in view of Ashton et al.(5,387,208), and Dragoo et al.(5,460,622). Reising et al. in view of Ashton and Dragoo discloses the unitary absorbent structure including an airlaid upper fibrous layer, a lower density acquisition zone, an airfelt lower storage layer, and containment layers as described in these claims.

---------- NEW CITATIONS ----------
NONE

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61F 13/46 — A1

(11) International Publication Number: **WO 99/63925**

(43) International Publication Date: 16 December 1999 (16.12.99)

(21) International Application Number: PCT/US99/13174

(22) International Filing Date: 8 June 1999 (08.06.99)

(30) Priority Data:
60/088,454 8 June 1998 (08.06.98) US

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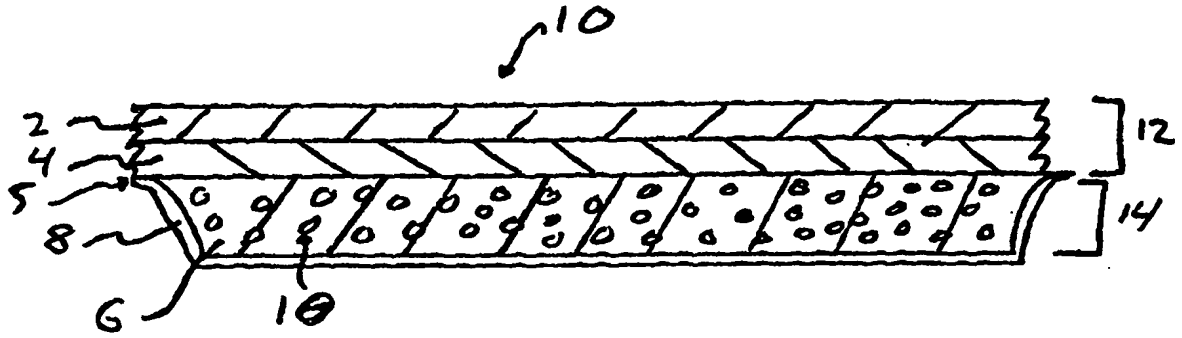
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: UNITARY ABSORBENT STRUCTURE CONTAINING SUPERABSORBENT POLYMER



(57) Abstract

Disclosed is a unitary absorbent structure (10), including an upper fibrous layer (12) having a liquid acquisition zone (2) extending to one surface, and a liquid distribution zone (4) extending to the other surface. A lower fibrous liquid storage layer (14) is in liquid communication with the distribution zone surface of the upper layer. The storage layer includes SAP particles (18). A containment layer (8) surrounds the storage layer and extends to the outer edges of the structure. The containment layer contains the fibers (6), and SAP particles of the storage layer against the distribution zone surface of the upper layer.

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UNITARY ABSORBENT STRUCTURE CONTAINING SUPERABSORBENT POLYMER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority under 35 U.S.C. 119 based upon U.S. Provisional Application Serial No. 60/088,454 filed June 8, 1998, the entire disclosure of which is hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to fibrous absorbent structures containing superabsorbent polymers useful in the manufacture of disposable diapers, adult incontinence pads, sanitary napkins and the like. More particularly, the invention is directed to an absorbent structure having sealed lateral edges to contain loose fibers and particles within the structure.

BACKGROUND OF THE INVENTION

Absorbent articles such as disposable diapers, adult incontinence pads, sanitary napkins and the like are generally provided with an absorbent core to receive and retain bodily liquids. The absorbent core is usually sandwiched between a liquid pervious top sheet, whose function is to allow the passage of fluid to the core, and a liquid impervious backsheet whose function is to contain the fluid and to prevent it from passing through the absorbent article to the garment of the wearer of the absorbent article.

An absorbent core for diapers and adult incontinence pads frequently includes fibrous batts or webs constructed of defiberized, loose, fluffed, hydrophilic, cellulosic fibers. The core may also include superabsorbent polymer (SAP) particles, granules, flakes or fibers. This core is typically referred to as a storage layer.

In recent years, market demand for an increasingly thinner and more comfortable absorbent article has increased. Such an article may be obtained by decreasing the thickness of the diaper core, by reducing the amount of fibrous material used in the core while increasing the amount of SAP particles, and by calendaring or pressing the core to reduce caliper and hence, increase density.

Such higher density cores do not absorb liquid as rapidly as lower density cores because densification of the core results in smaller effective pore size. Accordingly, to maintain suitable liquid absorption, it is necessary to provide a lower density layer having a larger pore size above the high density absorbent core to increase the rate of uptake of liquid discharged onto the absorbent article. The low density layer is typically referred to as an acquisition layer. Multiple layer absorbent core designs involve a more complicated manufacturing process.

The storage layer portion of a disposable diaper for example, is generally formed in place, during the converting process, from loose, fluffed cellulose. Such cellulose material is generally not available in preformed roll form because it exhibits insufficient web strength, owing to its lack of interfiber bonding or entanglement, to be unwound directly onto and handled in absorbent pad-making equipment.

Ultra-thin feminine napkins are generally produced from roll-goods based nonwoven material. Such a roll of preformed absorbent core material is unwound directly onto the absorbent article converting equipment without the defiberization step required for fluff-based products, such as diapers and incontinence pads. The nonwoven web is typically bonded or consolidated in a fashion that gives it sufficient strength to be handled in the converting process. These webs may also contain SAP particles.

The web consolidation mechanisms used in the roll-goods approach to making preformed cores provide strength and dimensional stability to the web. Such mechanisms include latex bonding, bonding with thermoplastic or

bicomponent fibers or thermoplastic powders, hydroentanglement, needlepunching, carding or the like.

However, while the web may be strengthened sufficiently for roll-goods converting, the strengthened web also constrains the swelling of SAP particles as the particles are trapped in the interstitial spaces of the web. The particles are unable to expand due to its increased strength and dimensional stability of the surrounding web. As a result, the ultimate absorbent capacity of the structure is diminished. In turn, higher basis weight and/or lower density absorbent core structures are required to provide the absorbent capacity required for high discharge volume products such a baby diapers and adult incontinence pads. Moreover, at high particle loadings such core structures exhibit poor particle containment. In other words, some of the particles tend to escape from the structure during manufacture, handling, shipping and converting. This can result in the fouling of manufacturing and converting equipment.

With regard to conventionally produced, absorbent structures, reference is made to U.S. Patent Nos. 5,009,650, 5,378,528, 5,128,082, 5,607,414, 5,147,343, 5,149,335, 5,522,810, 5,041,104, 5,176,668, 5,389,181, and 4,596,567, the disclosures of which are hereby incorporated by reference.

There is a need for an absorbent core material which facilitates fluid transport from an acquisition zone to a storage zone, exhibits good particle containment at high particle loading, is thin but has a high absorbent capacity in use, and can be delivered in roll-goods form to simplify the manufacturing and converting processes.

SUMMARY OF THE INVENTION

The present invention is directed to a unitary absorbent structure, including an upper fibrous layer having a liquid acquisition zone extending to one surface and a liquid distribution zone extending to the other surface. A lower fibrous liquid storage layer is in liquid

communication with the distribution zone surface of the upper layer. The storage layer includes SAP particles. A containment layer surrounds the storage layer and extends to the outer edges of the structure, the containment layer contains the fibers and SAP particles of the storage layer against the distribution zone surface of the upper layer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-section of a preferred unitary absorbent structure of the present invention.

FIG. 2 is a bottom view of the structure of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a stratified, unitary absorbent core structure having a density gradient through the thickness of the structure. The structure is a composite including at least two zones which confer upon the structure the ability to distribute fluids through the density gradient. These zones include an upper acquisition zone capable of rapidly acquiring liquid from insult, a distribution zone for laterally distributing the acquired liquid, and a storage zone for absorbing and storing the distributed liquid from the distribution zone and which has the capability to swell in the Z-direction to maximize the absorbent capacity of the material employed. The structure is sealed around its lateral edges to improve containment of unbonded or lightly bonded fibers or particles within the structure. Sealing may be accomplished by optionally providing a separate containment layer impermeable to loose fibers or loose particles, positioned below the storage zone of the structure.

The absorbent structure has the absorbent capacity of an unbonded airfelt structure with improved particle containment and may be delivered in roll-goods form, and is particularly useful as an absorbent core for disposable absorbent articles such as diapers, adult incontinence pads and briefs, and feminine sanitary napkins.

With reference to the drawings, the absorbent structure of the present invention includes a multilayer fibrous structure 10, having acquisition 2, distribution 4 and storage 14 zones. The acquisition and distribution zones of the structure are provided by acquisition - distribution layer 12 (ADL) which can be preformed or formed concurrently with the storage layer. The bonded structure may be formed by airlaid, wetlaid, thermobonding, carding or like techniques. The storage zone of the structure is provided by an airfelt layer of cellulosic fiber 6. The storage zone also includes SAP particles, granules or fibers 18. As used herein, an airfelt layer is a layer of airlaid fibers which are not bonded together. Because the airfelt layer has low web strength, it is formed by directly airlaying the cellulose fibers blended with SAP particles onto the distribution zone side 4 of the ADL 12. The structural integrity of the resultant ADL-airfelt structure is maintained by sealing the airfelt layer to the ADL. The seal is provided at such locations which will form the lateral edges of the absorbent core during converting. Preferably, a containment layer 8 is provided over the exposed surface of the airfelt layer of the structure. The containment layer is sealed to the structure to contain fibers 6 and particles 18. At the same time the containment layer is sealed to the structure to provide sufficient volume for the storage zone and SAP to swell without or substantially without constraint in the Z-direction.

The Acquisition-Distribution Layer

Preferably, the ADL of the present invention is a nonwoven structure having at least two discrete layers. The layer of the ADL closest to the wearer of the absorbent product (the top or acquisition layer) has a fiber content comprised entirely of modified cellulose or synthetic fibers and a binder resin. The layer of the ADL closest to the liquid storage (bottom) layer of the absorbent structure(the distribution layer) has a fiber content comprised primarily of air laid-fluff cellulose, chemically modified cellulose

fibers, crosslinked cellulose fibers, cotton linter fibers or mixtures thereof. The basis weight of each layer preferably ranges from 15 to 60 gsm for a total ADL basis weight of 30 to 120 gsm. Optionally, middle layers may be included. Such middle layers may have a fiber composition that is 100% fluff cellulose and/or chemically modified cellulose fibers or have a fiber composition that is a blend of synthetic fibers and cellulose fibers.

In a preferred embodiment, the acquisition layer side of the ADL is 80-90% by weight 6.7 wt/length of fiber dtex in size by 6mm in cut length polyester (PET) fiber bonded with 10-20% by weight of latex. The bottom or distribution layer is 80-90% fiberized fluff cellulose fibers bonded with 10-20% of an aqueous binder. The total basis weight of the ADL is 60 to 80 gsm and the top synthetic fiber layer is 25 to 50% of the total basis weight of the ADL. The fiberized fluff cellulose fibers may be selected from wood cellulose such as Foley fluff, cotton linter pulp, chemically modified cellulose such as crosslinked cellulose fibers or highly purified cellulose fibers, such as Buckeye HPF (each available from Buckeye Technologies, Inc., Memphis, Tennessee).

In an alternate preferred embodiment, the top layer and bottom layers of the ADL have the same composition as above, and also includes a middle layer of a blend of PET and cellulosic fibers. In this embodiment the top layer is at least 10% of the total ADL weight and the bottom layer is no more 50% of the total ADL basis weight.

The Storage Layer

As discussed above, the storage layer is preferably made from fiberized fluff cellulose fibers. Most preferred is wood cellulose such as Foley fluff. Also preferred is cotton linter pulp, chemically modified cellulose such as crosslinked cellulose fibers and highly purified cellulose fibers, such as Buckeye HPF (each available from Buckeye Technologies, Inc., Memphis,

Tennessee). The fluff fibers may be blended with synthetic fibers such as polyester such as PET, nylon, polyethylene or polypropylene. In addition, bicomponent thermoplastic fibers may be blended with the cellulose or synthetic fibers. The preferred thermoplastic fiber is Celbond Type 255 Bico fiber from Hoechst Celanese. The Bico fiber has a polyester core and an activated co-polyolefin sheath.

Airlaid Manufacture of the Absorbent Core

Preferably, the ADL is prepared as an airlaid web. The airlaid web is typically prepared by disintegrating or defiberizing a cellulose pulp sheet or sheets, typically by hammermill, to provide individualized fibers. The individualized fibers are then air conveyed to forming heads on the airlaid web forming machine. Several manufacturers make airlaid web forming machines, including M&J Fibretech of Denmark and Dan-Web, also of Denmark. The forming heads include rotating or agitated drums, generally in a race track configuration which serve to maintain fiber separation until the fibers are pulled by vacuum onto a foraminous condensing drum or foraminous forming conveyor (or forming wire). In the M&J machine, the forming head includes a rotary agitator above a screen. Other fibers, such as a synthetic thermoplastic fiber, may also be introduced to the forming head through a fiber dosing system which includes a fiber opener, a dosing unit and an air conveyor. Where two defined layers are desired, such as a fluff pulp distribution layer and a synthetic fiber acquisition layer, two separate forming heads are provided, one for each type of fiber.

The storage layer is preferably manufactured in airfelt form. As discussed above, an airfelt is made using airlaid equipment but no separate binders are employed. As contemplated for the present invention, a forming head of the airlaid web forming machine distributes the desired fiber for the storage zone of the absorbent core onto the ADL layers. Preferably, this fiber is a cellulose fluff. SAP granules are blended with the fluff to be distributed by

the forming head or are separately applied to the airfelt web by a dosing head. In addition to SAP, other functional particulates may be included in the airfelt. Such particulates include odor control agents, e.g., zeolites, fragrances, and the like.

The airlaid web is transferred from the forming wire to a calender or other densification stage to densify the web, increase its strength and control web thickness. The fibers of the web are then bonded by application of a latex spray or foam addition system, followed by drying or curing. Alternatively, or additionally, any thermoplastic fiber present in the web may be softened or partially melted by application of heat to bond the fibers of the web. The bonded web may then be calendered a second time to increase strength or emboss the web with a design or pattern. If thermoplastic fibers are present, hot calendering may be employed to impart patterned bonding to the web. Water may be added to the web if necessary to maintain specified or desired moisture content, to minimize dusting and to reduce the buildup of static electricity. The finished web is then rolled for future use.

Alternatively, to assemble the ADL and the airfelt layers, one can form the airfelt layer on the airlaid line. A previously manufactured airlaid ADL is unwound upstream of the airfelt layer forming and dosing heads. The containment layer is then unwound onto the airfelt layer. Next, the containment layer is sealed to contain the airfelt layer, SAP and other particulates.

The Containment Layer

The containment layer is intended to retain in place the unbonded or lightly bonded airfelt storage layer containing SAP and optionally other particles. The containment layer should retain but not constrain the fibers and SAP particles of the storage layer from swelling in the Z-direction upon liquid absorption. The containment layer need not serve as an absorbent layer and in fact it can also serve as a liquid impermeable bottom sheet. Suitable

materials for the containment layer include thermoplastic film, carded nonwoven or woven tissues, and the like. Examples of suitable thermoplastics include polyethylene and polypropylene.

The containment layer may be sealed to the absorbent structure in several ways. The containment layer may be made from a thermoplastic material which can be selectively heat sealed to the structure at desired locations. Alternatively, the containment layer may be sealed to the structure by applying a pressure sensitive or hot melt adhesive to the structure at desired seal locations before the containment layer is applied. A latex or other binder may also be employed as an adhesive. Ultrasonic welding may also be used to seal the containment layer to the structure. If a thermoplastic fiber is present in the storage layer, it may be used to seal the containment layer to the storage layer by the application of localized heat where seal formation is desired. The containment layer should not compress or otherwise constrain the underlying storage layer during sealing to an extent which would constrain the swelling of the storage layer upon absorption of liquid.

The absorbent core contemplated by the present invention is generally cut to rectangular, hourglass, T-shape, or other nested shapes, for use in diapers, adult incontinent pads and feminine hygiene pads. To form the seals at each edge of the rectangular core, it is preferred that the longitudinal seals (in the machine direction of the roll), be applied to the web, by for example a ribbed, heated calender to form heat seals along the web spaced apart the desired width of the absorbent core. The web is then slit in the machine direction at the heat seal to form separate webs of the desired absorbent core width, each narrow web having a heat seal along both edges. The narrow webs are then subjected to the application of spaced apart heat seals in the cross direction. In this manner, the slitting knives may divide a heat seal into two and avoid wasting material or leaving an exposed, non-sealed edge.

The heat seals to be slit must be of sufficient width to provide two effective seals after slitting. The spacing of these seals is determined by the desired length of the final absorbent core. Finally, the narrow web may be cut at the cross direction heat seal to form individual absorbent cores ready for conversion to the final product. Preferably, however, the narrow webs are not cut (although the cross direction heat seals may be perforated) and are rolled for shipment to the conversion site.

Wetlaid Manufacture of the Absorbent Core

Although airlaid web manufacturing methods are preferred for manufacturing the absorbent core of the present invention, wetlaid methods may alternatively be employed. To prepare the structure a multiple head box paper machine employing delta formers is used. The first head box distributes the acquisition zone fiber. The second head box distributes the distribution zone fiber. The resultant web is then passed through a dryer section before application of the storage zone fiber and SAP by airlaying. A containment layer is then applied to the structure and seal provided as discussed above.

WHAT IS CLAIMED IS:

1. A unitary absorbent structure, comprising:

an upper fibrous layer having a liquid acquisition zone extending to one surface and a liquid distribution zone extending to the other surface;

a lower fibrous liquid storage layer in liquid communication with the distribution zone surface of said upper layer, said storage layer including SAP particles; and

a containment layer surrounding the storage layer and extending to the outer edges of said structure, said containment layer containing the fibers and SAP particles of said storage layer against the distribution zone surface of the upper layer.

2. The structure of claim 1 wherein said upper fibrous layer is airlaid and the acquisition zone has a lower density than the distribution zone.

3. The structure of claim 1 wherein said lower storage layer is an airfelt.

4. The structure of claim 1 wherein the containment layer is sealed to at least one lateral edge of said struture.

5. The structure of claim 4 wherein said containment layer is sealed directly to the distribution zone surface of said upper layer.

6. The structure of claim 4 wherein said containment layer is sealed directly to the lower storage layer.

7. The structure of claim 1 wherein said containment layer is selected from the group consisting of thermoplastic film, nonwoven and woven tissue.

8. The structure of claim 1 wherein said thermoplastic film is selected from the group consisting of polyethylene and polypropylene.

9. The structure of claim 3 wherein said airfelt layer is lightly bonded.

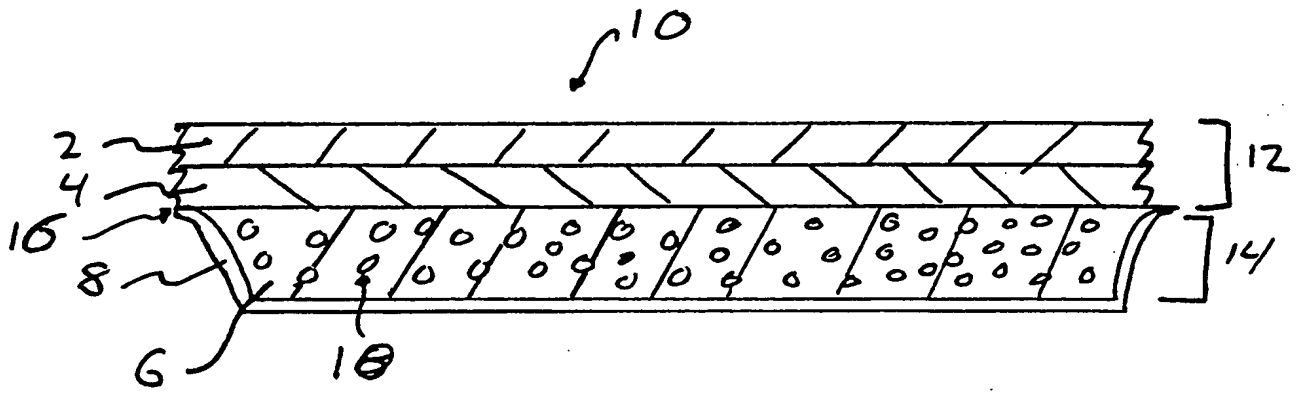

Fig 1

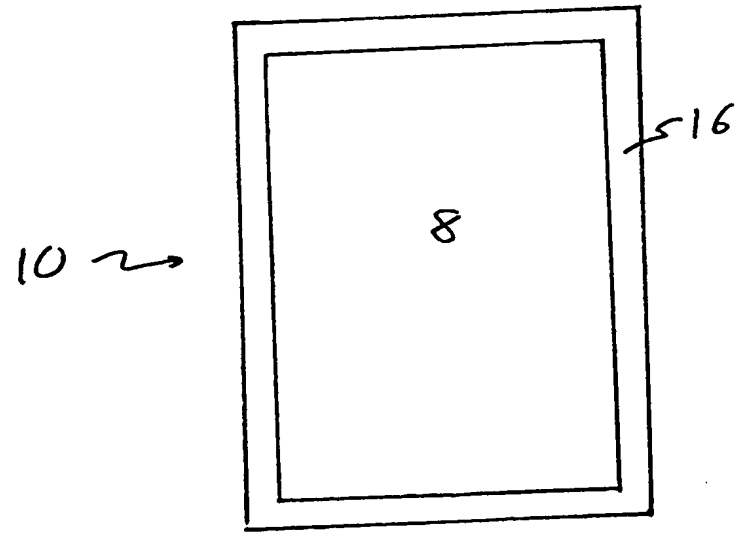

Fig 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/13174

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61F 13/46
US CL : 604/367, 368, 378
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 604/367, 368, 378

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS
Search Terms: acquisition, distribution, superabsorbent

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,988,344 A (REISING et al) 29 January 1991, entire document.	1, 4, 7
Y	US 5,387,208 A (ASHTON et al) 07 February 1995, col. 6 line 60 to col. 7 line 68.	1-9
Y	US 5,460,622 A (DRAGOO et al) 24 October 1995, col. 7 line 15 to col. 10 line 42.	1-9
A	US 5,681,300 A (AHR et al) 28 October 1997, col. 7 line 10 to col. 9 line 12.	1-9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 19 JULY 1999	Date of mailing of the international search report 23 AUG 1999
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Form PCT/ISA/210 (second sheet)(July 1992)★